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For Efficient Dairy Plant Operation

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REFRIGERATION PLANT TROUBLESHOOTING: 2. SYSTEM

This bulletin includes technical and latest development on products, systems, techniques etc. reported in journals, companies' leaflets and books and based on studies and experience. The technical information in different issues is on different areas of plant operation. It is hoped that the information contained herein, if employed in the dairy plant, will help in making its operations more efficient.

The theme of information in this issue is **Refrigeration Plant Troubleshooting (System).** It may be understood that the information given here is by no means complete.

In this issue ...

1. INTRODUCTION

The last issue of Technews (May- June 2000) detailed the refrigeration equipment – related problems, their causes and remedies. This issue provides guide for refrigeration system – related problems, their causes and remedies.

2. SYSTEM SHORT OF CAPACITY

Symptom / Possible Causes	Suggested Remedial Measures
a) Product temperature high	
▪ Blocked liquid strainers and solenoid valves.	*Clean or replace.*
▪ Plant heat loads too high.	*Reduce load, add extra compressors and/or evaporators.*
▪ Liquid feed valve under-feeding evaporators.	*Repair and reset valves.*
▪ Faulty control circuit.	*Check and reset or repair. Take special note of capacity control and low suction pressure settings.*
▪ Defective thermostat controlling product temperature.	*Check temperature and thermostat, then replace or adjust.*
▪ Hot gas defrost valve faulty.	*Check and repair as needed*
▪ Low refrigerant level in receiver.	*Check level on sight-glass and charge system to correct level.*
b) Expansion valve hisses or Bubbles are visible in liquid line sightglass	
▪ Flash gas in liquid line.	*Add refrigerant to system.*
c) Short-cycling or continuous Running	
▪ Expansion valve blocked or jammed.	*Clean or replace.*
▪ Incorrectly sized expansion valve.	*Replace with correctly sized valve*
▪ Low refrigerant charge.	*Recharge.*

Symptom / Possible Causes	Suggested Remedial Measures
d) High suction pressure	
▪ See section 5	
e) High suction temperature	
▪ Large pressure drop across evaporator.	*Check superheat and reset expansion valve*
f) Low suction pressure	
▪ Lubricating oil covering evaporator surfaces.	*Drain oil from evaporators and purge clean surfaces.*
g) Oil not returning to sump.	
▪ See section 11	
h) Compressor noisy.	
▪ See Technews issue 26, section 8	
i) Compressor worn internally.	
▪ See Technews issue 26, section 8	
j) No other symptom	
▪ Water contamination in the refrigerant.	*Remove water from the system.*

3. HIGH DISCHARGE PRESSURE

Symptom / Possible Causes	Suggested Remedial Measures
a) Faulty condenser	
▪ See Technews issue 26, section 12	
b) No other symptoms	
▪ Air or other non-condensible gases in system.	*Purge.*
▪ Check discharge valves partly closed.	*Open the valves fully*
▪ Liquid refrigerant in compressor. Compressor operation noisy.	*Remove excess refrigerant from system, reset controls.*
▪ No water in cooling tower.	*Check ball cock, valves and pump, repair, open cock or replace as appropriate.*

Symptom / Possible Causes	Suggested Remedial Measures
▪ Too much refrigerant in the system.	*Remove refrigerant until level is visible in liquid receiver sightglass.*
▪ Increased demand for refrigeration output	*Start extra compressor, set compressor capacity control.*

4. LOW DISCHARGE PRESSURE

Symptom / Possible Causes	Suggested Remedial Measures
a) Water leaving condenser too cold	
▪ Water flow rate too high.	*Adjust water flow by regulating valve.*
b) Lack of refrigerant	
▪ Check for leaks.	*Repair & Recharge refrigerant.*
▪ Check relief (safety) valves to atmosphere.	*Replace if necessary.*
c) Suction pressure rises rapidly after shutdown (reciprocating compressors only)	
▪ Broken or leaking discharge valves.	*Repair or replace as required.*
▪ Worn rotor tips in screw compressor	*Repair or replace as required.*
▪ Incorrect grade of oil preventing rotors from sealing in screw compressor only.	*Change oil. Use specified grade of oil.*
▪ If compressor runs backwards after shutdown, check suction and discharge check valves.	*Repair or replace as appropriate.*
d) Low discharge pressure and high suction pressure.	
▪ Damaged leaky relief by pass valve.	*Inspect valve repair or replace as necessary.*

Symptom / Possible Causes	Suggested Remedial Measures
e) Capacity control not functioning. ▪ See Technews issue 26, section 9	

5. HIGH SUCTION PRESSURE

Symptom / Possible Causes	Suggested Remedial Measures
a) Product temperature high	
▪ Additional refrigeration load added.	*Compressor runs continuously Check heat loads. Reduce load, speed up compressor or start extra compressor(s), condensers and/or evaporators.*
b) Capacity control not working.	
▪ See Technews issue 26, section 9	
c) Compressor noisy	
▪ Defective solenoid valves continuing to feed refrigerant to evaporators when they are switched off.	*Check coil and mechanical components. Renew or replace as necessary.*
▪ Liquid refrigerant in suction vapour.	*Re-check evaporator controls in items above. Install liquid traps in suction lines if problem persists.*
d) Compressor worn internally.	
▪ See Technews issue 26, section 8	
e) Abnormally cold suction line in dry expansion systems	
▪ Overfeeding of expansion valve.	*Close valve to correct setting*
▪ Expansion valve stuck fully open.	*Repair and clean or replace valve.*
▪ Expansion valve sized too large.	*Replace with correctly sized valve.*

6. LOW SUCTION PRESSURE

Symptom / Possible Causes	Suggested Remedial Measures
a) Lack of refrigerant	
▪ Check for leaks.	*Repair & Recharge system.*
▪ Low or no refrigerant supply to evaporators, Blocked liquid feed strainers.	*Clean.*
▪ Check & clean evap. controls.	*Reset.*
▪ Liquid solenoid valves not working.	*Check solenoid coil. Replace if burnt out and check mechanical function of valve. Replace if necessary.*
▪ Hand expansion valve closed.	*Open to correct setting.*
▪ Expansion valve too small.	*Repair or replace.*
▪ Float switch faulty.	*Repair or replace.*
b) Partial (or complete) freeze-up of evaporator	
▪ Thaw out tubes or defrost fins.	*Install hot gas line and controls for rapid thawing.*
c) Evaporator fouled	
▪ Fouled by oil or product deposits.	*Drain oil and clean surfaces chemically or mechanically (rod or brush)*
d) Compressor short-cycles.	
▪ See Technews issue 26, section 5	
e) Capacity control not modulating.	
▪ See Technews issue 26, section 9	
f) No other symptoms.	
▪ Excessive suction line pressure drop.	*Check that stop valves are open and clean suction strainer.*
▪ Evaporator too small to meet load.	
▪ Heat loads satisfied or no load.	

7. HIGH OIL PRESSURE

Symptom / Possible Causes	Suggested Remedial Measures
a). Low oil temperature.	
▪ See section 10.	
b) No other symptoms	
▪ Oil pressure relief valve and/or oil pressure regulating valve adjusted incorrectly or faulty.	*Adjust or replace*
▪ Gauge Defective	*Repair or replace*
▪ Oil section stop valve closed.	*Open oil suction stop valve wide.*

8. LOW OIL PRESSURE

Symptom / Possible Causes	Suggested Remedial Measures
a) Oil pressure warning lamp on	
▪ Oil pressure relief valve and/or oil pressure regulating valve adjusted incorrectly or faulty.	*Adjust or replace.*
▪ Blocked oil strainer and/or filter.	*Clean or replace as necessary (some oil filter cartridges must be discarded, not cleaned)*
▪ Low oil level indicated on sightglass.	*Check level. Top up to required level.*
▪ Worn or broken oil pump components.	*Repair or replace as necessary.*
▪ Oil pump motor faulty.	*Repair.*
▪ Worn compressor bearings.	*Check for cause. Repair or replace*
▪ Liquid refrigerant in oil.	*Check oil heater and evaporator controls. Reset to required settings.*

Symptom / Possible Causes	Suggested Remedial Measures
▪ Water in oil.	*Change oil. Check oil cooler for any leaks. Repair, remove water from system.*
▪ Vapour in oil cooler.	*Check vent line and purge vapours.*
▪ Wrong oil type.	*Drain oil and fill with correct grade.*
▪ Oil pressure regulator set too low.	*Reset the regulator as per operating conditions.*
Important: Never mix grades of oil. Never use reciprocating compressor oil in a screw compressor.	

9. HIGH OIL TEMPERATURE

Symptom / Possible Causes	Suggested Remedial Measures
a) High discharge temperature.	
▪ See section 12	
b) Water-cooled compressors	
▪ Water regulating valve out of adjustment or defective.	*Adjust or replace.*
▪ Low water supply. Check water flow and temperatures.	*Clean strainers and check & overhaul pump if necessary.*
▪ Dirty (scales) oil cooler.	*Check water supply and clean cooler. Treat water supply if needed.*
c) Liquid injection cooled compressors	
▪ Low refrigerant supply.	*Check liquid supply piping and valves. Open, adjust or repair as appropriate.*
▪ Low liquid refrigerant level in receiver.	*Check and recharge system.*
▪ Oil in liquid refrigerant supply.	*Drain oil from liquid receiver and check oil carryover. See problem 11.*

Symptom / Possible Causes	Suggested Remedial Measures
▪ Incorrectly set or faulty components regulating refrigerant feed.	*Check regulating valve, liquid solenoid, regulating valve bulb, etc. Reset, repair or replace as required.*
d) Compressors without oil coolers ▪ High suction temperature superheat.	*Check refrigerant charge and expansion valve operation. Top charge, repair or replace valve as required.*
▪ Operation at high compression ratio.	*Check operating limits with supplier or manufacturer.*
e) Float valve and oil separator is leaking	*Repair the float valve.*

10. LOW OIL TEMPERATURE

Symptom / Possible Causes	Suggested Remedial Measures
a) Oil pump noisy ▪ Liquid refrigerant in oil. Check evaporator controls.	*Reset or repair as necessary.*
b) Oil separator sump cool ▪ Oil heater not operating.	*Check thermostat and oil heater element for an open circuit. Repair.*
c) No other symptoms ▪ Oil coolant regulating valve out of adjustment or defective.	*Adjust or replace.*

11. HIGH OIL CONSUMPTION (COMPRESSOR LOSES OIL)

Symptom / Possible Causes	Suggested Remedial Measures
a) Oil level in sightglass low	
▪ Oil not returning from oil separator.	*Check and clean or replace valves, orifice plates strainers and separator elements.*
b) No other symptom	
▪ Oil level too high	*Drain to correct level using drains provided*
▪ Liquid refrigerant returning in compressor suction line.	*Check evaporator controls. Clean and reset or replace. Consider use of suction liquid traps if problem persists.*
▪ Oil vaporisation because of high discharge temperature of high suction pressure.	*Check and adjust expansion valve to correct setting.*
▪ Defective oil heater in sump.	*Adjust or replace.*
▪ Suction check valve defective.	*Repair or replace.*
▪ Air in system causing oil to carbonise or vaporize.	*Purge air, remove oil deposits and clean components.*
▪ Coalescer filter blocked.	*Change coalescer.*
Important: Note that refrigeration compressors do not "burn" oil. It is circulated within the system.	
c) Oil spillages visible	
▪ Check fittings for leaks.	*Repair as needed.*

12. HIGH DISCHARGE GAS TEMPERATURE

Symptom / Possible Causes	Suggested Remedial Measures
a) High oil temperature.	
▪ See section 9	

Symptom / Possible Causes	Suggested Remedial Measures
b) High discharge pressure. ▪ See section 3	
c) High suction pressure. ▪ See section 5	*Check system heat loads, adjust liquid feed to the evaporator*
d) Product too warm. ▪ Evaporator heat load too high, resulting in high suction superheat.	*Clean or replace*
e) Low oil pressure ▪ Blocked oil strainer.	*Set the limits as required for plant operations.*
f) No other symptoms ▪ Operation at high compression ratio. (abnormally low suction pressure or high discharge pressure). ▪ Broken discharge valve. ▪ Leaking by pass valve. ▪ Water present in refrigeration system	*Change the valve* *Rectify leakage or replace valve.* *Remove the water from system.*

SOME USEFUL REFERENCES

1. **Eclipse High Stage, Booster and 2 Stage Compressor – Installation, Operation & Service instructions**, Frick India Ltd.

2. Elonka, S.M. and Minich, Q.W. (1979), **Standard Refrigeration and Airconditioning Questions & Answers**, Tata McGraw Hill Publications, 2nd Edition.

3. **Grasso Screw Compressor Packages Medium Series : User Manual**, GEA Grasso GmbH Feb. 1997

4. Nielsen, P.S., **Effects of Water Contamination in Ammonia Refrigeration Systems**, Danfoss Industrial Refrigeration A/S, Denmark

5. **SAB 202, Screw Compressor Instruction Manual** (0178 – 250 EN): Sabro Refrigeration A/S, Denmark

6. Th. Witt Kaltemaschinenfabrik GmbH, **Installation and Operating Instructions for Refrigerant Pumps** (10015E), May 1996

7. White, R., Adamson, B and Happe, C (1991) Trouble shooting Industrial Refrigeration Equipment **ASHRAE Journal**, Vol. 33